

# The effect of facial motion on same and other race recognition

## The effect of motion at encoding and retrieval for same and other race face recognition

Natalie Butcher<sup>1</sup>, Karen Lander<sup>2</sup>, Hui Fang<sup>3</sup>, Nick Costen<sup>4</sup>

<sup>1</sup>Teesside University

<sup>2</sup>University of Manchester

<sup>3</sup>Swansea University

<sup>4</sup>Manchester Metropolitan University

Correspondence to: Karen Lander, School of Psychological Sciences, University of Manchester, Manchester M13 9PL, UK. Phone: +44 (0)161 275 2598. Email: [karen.lander@manchester.ac.uk](mailto:karen.lander@manchester.ac.uk)

### **Abstract**

In an experimental study we assessed the role of motion when encoding and recognising unfamiliar faces, using an old / new recognition memory paradigm. Our findings revealed a clear advantage for learning unfamiliar faces moving non-rigidly, compared with static faces. This advantage for motion was found with both same and other-race faces. Furthermore, results indicate that it is more important that the face is learnt in motion than recognised from a moving clip. Interestingly, despite a reliable other race effect being revealed, participants were able to utilise motion information exhibited by other-race faces in a manner akin to the motion advantage found for same-race faces. The implications of these findings are discussed in relation to the nature of the stored face representations, considering whether the facilitative role found here can be explained by factors other than motion per se.

Keywords: Facial motion, encoding, retrieval, own and other race faces

Face recognition in humans is one of the most highly developed visual perceptual skills. Indeed, faces are naturally intricate structures composed of multiple complex features (e.g. eyes) which are themselves constructed from multiple lower-level features (e.g. contrast, frequency, orientation), located and orientated according to a unique configuration (Peterson, Abbey & Eckstein, 2009). Yet, in everyday life, the task of recognising and identifying individuals from their face is undertaken with relative ease and with little apparent effort (Christie & Bruce, 1998). Variations in lighting and viewpoint, among other non-optimal viewing conditions, are encountered in everyday life yet face recognition remains highly accurate (Braje, Kersten, Tarr, & Troje, 1998; Hill, Schyns & Akamatsu, 1997). In the present study we investigate the effect of two factors that have been demonstrated to affect our ability to recognise faces in everyday life; facial motion and race.

There has been considerable research into the area of face recognition typically using static images (photographs). However the faces we see on a day to day basis tend to be moving. Faces move in both rigid (head nodding and shaking) and non-rigid ways (expressions, speech). It is known that seeing the face move is important in the perception of visual speech (see Massaro, 1998 for a review) and that dynamic parameters have been shown to influence expression perception (Kamachi, et al., 2001). In addition, facial motion can also provide cues to identity independently of the underlying shape and texture of a face. This is demonstrated in the ability of impersonators to mimic the ways in which famous people move their heads and faces (Hill & Johnston, 2001). Furthermore, previous research has demonstrated that movements shown by a face can facilitate face recognition, leading to more accurate (Christie & Bruce, 1998; Lander, Christie, & Bruce, 1999; Pike, Kemp, Towell, & Phillips, 1997) and faster (Pilz, Bülthoff & Vuong, 2009; Pilz, Thornton & Bülthoff, 2006) recognition, when results are compared to recognition from a single static image or multiple static images (Lander et al., 1999; Pike et al., 1997). Determining the role of motion for face recognition may help us understand how different aspects of face perception are linked (Bruce & Young, 1986). Here, several models have aimed to map the cognitive and neural processing of both changeable and non-changeable aspects of the face (see Haxby, Hoffman & Gobbini, 2002; O'Toole, Roark & Abdi, 2002).

Knight and Johnston (1997) proposed that viewing a face moving provides information about the three-dimensional structure of the face, allowing the recognition of the characteristic facial features idiosyncratic to that individual. This idea of a moving image improving the perception of the three-dimensional structure embodies one of the dominant hypotheses in the literature regarding the role of motion in facial recognition, the

representation enhancement hypothesis (O'Toole et al., 2002). The representation enhancement hypothesis, (O'Toole et al., 2002) suggests that facial motion aids recognition by facilitating the perception of the three-dimensional structure of the face. As this hypothesis is not dependent on any previous experience with an individual face then it may be important in understanding how motion aids recognition and learning of previously unfamiliar faces. It posits that the quality of the structural information available from a human face is enhanced by facial motion and this benefit surpasses the benefit provided by merely seeing the face from many static viewpoints (Christie & Bruce, 1998; Lander et al., 1999; Pike, et al., 1997). This notion is supported by experimental findings that have aimed to distinguish between recognition effects due to the number of views seen and those due to the motion of the head per se because rigid head movements, in particular, provide the viewer with additional perspective views of the face. Results have, to date, provided no evidence to support the idea that the motion advantage can be accounted for by the additional viewpoint information provided by a moving sequence alone, as presentation of multiple static images of a face are not seen to yield the same level of performance as the moving condition (Christie & Bruce, 1998; Lander et al., 1999; Pike, et al., 1997). It is worth noting here that for this reason a multiple static condition is not be utilised in the present study. Furthermore whilst non-rigid motions (such as those displayed in the present study) can provide additional views of the face, non-rigid motions are not seen to present the viewer with the same kind of sweeping rotation and flexion movements characteristic of rigid facial motions (Roark, Barrett, Spence, Abdi & O'Toole, 2003), so it is unlikely that any non-rigid motion advantage presented in the current findings can be explained entirely by the additional viewpoint information provided by the moving stimulus.

A second hypothesis regarding the role of motion in face recognition is the supplemental information hypothesis (O'Toole et al., 2002). The supplemental hypothesis assumes that we represent the characteristic facial motions of an individual's face as part of the stored facial representation for that individual. For the particular individual's characteristic facial motions to be learnt, to the extent where they become intrinsic to that person's facial representation, experience with the face is needed. Learning and experience with an individual's facial motion is vital to this hypothesis and, as such, the supplemental information hypothesis is crucial to understanding the motion advantage for familiar faces and understanding how effective face learning occurs. This hypothesis is supported by studies that have found more accurate recognition of negated famous faces when seen in motion than when presented statically (Lander, Christie, & Bruce, 1999). Therefore, for

familiar faces, both rigid and non-rigid motion is seen to play a facilitative role at the retrieval stage of recognition, once a person's characteristic facial motion has been integrated into the face's representation. It is important to note that the two dominant theoretical explanations of the motion advantage in facial recognition (representational enhancement hypothesis & supplemental information hypothesis) are not mutually exclusive, and the relative input of each may be mediated by various factors including, familiarity, task demands and the distinctiveness of the face's motion (Butcher, 2009).

Although the motion advantage has been demonstrated for familiar and unfamiliar face recognition (Christie & Bruce, 1998; Knight & Johnston, 1997; Lander et al., 1999; Pike et al., 1997), the effect has been shown to be more robust for familiar faces. Furthermore, research to date has been inconsistent with regards what, if any, benefit non-rigid motion information provides during the learning and recognition of unfamiliar faces. We examine what effect the availability of non-rigid facial motion has at the learning and retrieval stages of recognition (within the same experiment), in order to further probe what facilitative role motion can provide for the recognition of previously unfamiliar faces.

Buratto, Matthews and Lamberts (2009) investigated the motion advantage for images using an old/new recognition task and consistently found a study-test congruency effect. For any given presentation style (static, multi-static and dynamic) accuracy was found to be greatest when items were shown at recognition in the same format as they had been learnt, providing support for previous demonstrations of study-test congruency when learning images (Matthews, Benjamin & Osborne, 2007). However, in the second experiment presented in Buratto et al., (2009) both an 'inclusion' and an 'exclusion' condition were employed. In the inclusion condition participants were required to respond 'old' based solely on the content of the clip, regardless of the presentation style (static, multi-static or moving). In contrast, participants in the exclusion condition were to respond 'old' based on both the content of the clip and the presentation mode. Therefore, participants in the exclusion condition were asked to make a 'new' response for images that had been presented previously in the study phase but in a different presentation style. The inclusion condition was akin to the procedure used in the present study as participants were similarly asked to respond 'old' based solely on the content of the clip, regardless of the presentation style. For the inclusion condition Buratto et al., (2009) found a main effect of presentation style at encoding with recognition sensitivity highest for images learnt in motion compared to multi-static or single static presentation. Buratto et al., (2009) found no effect of presentation style at recognition in the inclusion condition. In our presented experiment we

investigate whether the recognition of unfamiliar faces is affected by encoding with motion information in the same manner as unfamiliar images were seen to be in Buratto et al., (2009). We hypothesise, in support of the representation enhancement hypothesis (O'Toole et al., 2002), that the facilitative role of non-rigid motion for unfamiliar face stimuli may be a product of the construction of more robust mental representations at encoding.

It is interesting to investigate this hypothesis for other-race faces as well as same-race faces as it has long been established that other-race faces are recognised with less proficiency than same-race faces (see Hancock, Bruce & Burton, 2000). Crucially, there is no universally accepted agreement on the mechanisms responsible for the other race effect and a theoretical explanation for the phenomenon is yet to be achieved (Meissner, Brigham, & Butz, 2005; Meissner & Brigham, 2001). Furthermore, there has, to date, been no such investigation of the effect motion has on the recognition of other-race faces despite the type of facial motions exhibited across different race faces being seen to vary (Tzou et al., 2005). For instance, Tzou et al., (2005) found that in general Europeans exhibit larger facial movements than Asians. In particular, Europeans display significantly larger movements in the eyebrow, nose and mouth regions, although Asians were revealed to display larger movement of the eyelids. One explanation of the other race effect has suggested that other race observers lack experience with the dimensions appropriate to code other-race faces efficiently (Sporer, 2001). This is argued to lead to difficulty when individuating between different exemplars of other-race faces and the use of non-optimal encoding strategies based on featural rather than configural processing (Bothwell, Brigham & Malpass, 1989; Chance, Turner & Goldstein, 1982; Levin, 2000). If a lack of expertise in processing other race faces explains the other race effect then other race observers may also lack the expertise with which to process individuating motion information exhibited by other-race faces. However, in training studies familiarisation with other-race faces has been demonstrated to reduce the 'other race effect' and increase levels of configural and holistic processing (McKone, Brewer, MacPherson, Rhodes & Hayward, 2007). Viewing a moving face may enable the creation of more robust, descriptive face representations that increase the salience of individuating information when compared to static faces. If this is the case enhanced encoding of other race faces as a product of motion information may lead to motion being seen to be beneficial to the recognition of unfamiliar other-race faces as it is for same-race faces (see Lander & Bruce, 2003).

Therefore, we examine, using an old/new recognition paradigm, the separate and interactive effect of the availability of non-rigid facial motion at both learning and

recognition in order to enhance understanding of the parameters of recognition in two key areas. Firstly, we investigate whether non-rigid facial motion can facilitate more accurate recognition, and if so, at what stage of the face recognition process (encoding or retrieval) the facilitative role is evident. Through employing four experimental conditions (1. static learning with static recognition, 2. static learning with moving recognition, 3. moving learning with moving recognition and 4. moving learning with static at recognition) it is possible to explore the relative importance of facial motion being available to the viewer at both encoding and retrieval. Secondly using a stimulus set of both British Caucasian and Japanese faces, we investigate whether learning another race face in motion can increase recognition.

## **Method**

Participants. A sample of 120 undergraduate students (31 male and 89 female) were recruited within the University of Manchester's School of Psychological Sciences Department. All participants were Caucasian and had normal or corrected-to-normal vision. Participants' ages ranged from 19 to 59 with a mean age of 23 years and 3 months. All participants were allocated 2 participation credits for their time. None of the participants were familiar with any of the stimuli used.

Design. The experiment utilized a between participants design with 3 independent variables manipulated; race of the stimulus face (British Caucasian or Japanese), presentation style at learning (moving or static) and presentation style at recognition (moving or static). Participants were randomly assigned to complete one of the 8 experimental conditions. One dependent variable was measured; recognition accuracy. Hit and false alarm rates were measured, leading to calculation of both A' and B'' scores (Snodgrass & Corwin, 1988). The design consisted of a learning phase and a recognition phase.

Stimuli and Apparatus. The faces were selected from a bank of colour video sequences of British Caucasian and Japanese faces previously used for facial recognition experiments (Lander, Hill, Kamachi, Vatikiotis-Bateson, 2007). All sequences displayed at least the head and shoulders of the subject and were shot from a frontal position from a standardised distance. All stimuli were collected using the same equipment and depicted the face in front

of the same background screen. During the moving sequences the target face was seen speaking, with the same standardised sentence spoken by both the Caucasian and Japanese subjects ("It's fifteen minutes to three") although the Japanese subjects spoke in their native Japanese language. For the static condition, a single freeze frame was selected from the original video sequence at a stage in the video when the face was considered to be displaying a neutral expression. The static freeze frame was not compressed when exported from the video-editing suite, which resulted in no loss of image quality. Thus, any impairment in the static condition is unlikely to reflect a difference in image quality. Images were shown for a duration of 2 seconds and were presented on a G4 PowerMac using Psyscope software (Cohen et al., 1993). All the movies were presented in the centre of a 40.6cm x 30.5cm Mitsubishi, Diamond Plus 230 screen and were 9 x 6cm in size (320 x 240 pixels). However, the size of the face on the screen varied in width due to the nature of the footage. The space the face took up in the 9 x 6cm area varied from 2.6cm to 3.9cm in width (British Caucasian between 2.9cm and 3.8cm, Japanese between 2.6cm and 3.9cm).

Both the static images and moving clips used in the recognition phase differed to the ones used in the learning phase. For the moving test stimuli a second movie sequence of the target identity was utilised and for the static test stimuli a second freeze frame was captured from that sequence. The images remained similar to the learning images in that they were shot from the same distance during the same recording session so background screen remained the same across learning and recognition and the subjects hairstyles also remained the same. This procedure was implemented in order to eliminate picture matching strategies being adopted (e.g., Baddeley & Woodhead, 1983; Sporer, 1991). Therefore, any differences in recognition performance cannot be attributed to participants recognising a particular stimulus. Instead, this procedure ensures that the recognition task involves the recognition of a particular face.

Procedure. Participants were tested separately and seated approximately 60cm from the screen. In the learning phase, participants were informed that they would be shown 20 faces one at a time (for 2 seconds; shown moving or static) and that they were to watch the faces carefully. The faces were displayed in a set random order with a 4 second interval (white blank screen displayed) between each face. When the learning phase was complete the participant was given a 30 second break to read instructions for the test phase to follow.

In the recognition phase participants were shown a total of 40 faces (as either single static images or moving clip), 20 of which were faces shown during the learning phase while



the other 20 were distracter faces of the same race to the learnt faces. The faces were presented one at a time. Participants were told that some of the 40 faces they were to see would be old 'familiar' faces they had seen in the learning phase, while other faces would be new 'unfamiliar faces'. After each face was displayed the participant was to indicate whether they recognised the face or not using corresponding keys to represent an 'old' or 'new' response.

## Results

The mean overall hit rate was 77.25% (see Table 1), the false alarm rate was 14.22%. Table 1 provides details of the mean hits, false alarms (FA), A' and B'' for each of the 8 experimental conditions. A series of 2 (Race) X 2 (Learning presentation style) X 2 (Recognition presentation style) between participants ANOVA were conducted.

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Table 1 about here  
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Hits and FA analysis. A significant main effect of race,  $F(1,119) = 14.91, p < 0.01$  was found, indicating that participants were more sensitive when recognising faces of the same race as their own (British Caucasian) than faces from an other race (Japanese). A significant main effect of learning presentation style,  $F(1,119) = 36.53, p < 0.01$  was also found on the hits. Participants, who learnt the target faces in motion, were more accurate at recognising the faces than were participants who learnt the faces from static images. However, no significant main effect of presentation style at recognition was found,  $F(1,119) = 0.18, p = 0.68$  indicating that there was no difference between recognising the target faces from static or with facial motion.. There were no interaction effects, all  $F < 0.70$  and  $p > 0.40$ . Analysis of the false alarms displayed main effects of race,  $F(1,119) = 3.99, p < 0.05$  and presentation style at learning,  $F(1,119) = 6.17, p < 0.05$  but no effect of presentation style at recognition,  $F(1,119) = 0.13, p = 0.72$  or any interaction effects, all  $F < 0.20, p > 0.65$ .

A' and B'' analysis. Similarly to the hits analysis, A' analysis revealed a main effect of race,  $F(1,119) = 10.87, p < 0.01$  and a main effect of presentation style at learning,  $F(1,119) =$

27.42,  $p < 0.01$ . There was no effect of presentation style at recognition,  $F(1,119) = 0.39$ ,  $p = 0.53$  or any interactions, all  $F < 0.16$ ,  $p > 0.69$  further demonstrating there was no advantage gained from the availability of motion information at recognition across the experimental conditions. Analysis of B" scores found no main effects; race,  $F(1,119) = 0.003$ ,  $p = 0.93$ , presentation style at learning,  $F(1,119) = 0.19$ ,  $p = 0.66$  or presentation style at recognition,  $F(1,119) = 0.69$ ,  $p = 0.41$ . No interactions were found, all  $F < 0.47$  and  $p > 0.50$ .

## Discussion

Our findings reveal the following points:

First, that faces viewed in motion during learning were correctly recognised more often than faces learnt as a static image. Interestingly our moving faces displayed a naturalistic mixture of predominantly non-rigid (talking, expressing) with some limited rigid (head nodding and shaking) movements. Previously it has been proposed that seeing the face move rigidly provides more depth and structural facial information regarding the identity of the person (Knappmeyer et al., 2003). In addition, Lander et al., (2007) proposed that viewing a non-rigidly moving face may lead to greater attention being paid to it, which in turn leads to better recognition. As the motion displayed in the current study was predominantly non-rigid it is not possible to say whether the results are a reflection of non-rigid motion specifically or whether the results can be generalised to other types of facial motion. Indeed, findings suggest that different facial motions may have different effects on memory for faces (Roark et al., 2003). Such consideration may account for the divergence in findings that have previously demonstrated, for unfamiliar faces, an unclear picture as to whether motion can benefit or even hinder recognition (Pike et al., 1997; Christie & Bruce 1998; Bruce et al., 1999). It is therefore important that in the current study the effect of non-rigid motion is specifically addressed in relation to unfamiliar face recognition in an aim to isolate the contribution of different types of motion information when recognising unfamiliar faces. As Roark et al., (2003) suggest, such considerations of the type of motion tested may help to reconcile the previously found divergent results and offer new insights into understanding face identification under naturalistic contexts. Whatever the explanation of the motion advantage, it is clear that viewing a face in motion leads to a more robust representation (Pilz et al., 2009), than can be formed from a single image alone. It is important to note that although we cannot rule out the possibility that our results are due to

the increased number of images presented in a moving sequence, this interpretation seems unlikely. Indeed previous work has established that the presentation of multiple static images of a face does not lead to the same level of performance as in a moving condition (see Christie & Bruce, 1998; Lander et al., 1999; Pike, et al., 1997). Furthermore, in previous work, the largest beneficial effect for motion is found with naturally moving images, rather than those displayed in reverse, with their temporal characteristics amended or rhythm disrupted (Lander & Bruce, 2000), suggesting a key role for motion per se rather than multiple images.

It is worth noting that our results found that seeing a face moving non-rigidly aids the learning of other race faces, as well as own race faces. This finding is new and to our knowledge has not been demonstrated previously. Thus participants were able to use facial motion information exhibited by other-race faces at encoding as an aid to recognition, as they have been seen to do for same-race faces (Knappmeyer et al, 2003; Lander & Bruce, 2003; Thornton & Kourtzi, 2002). Explanations of the other race effect have suggested that individuating information is ignored with categorical / race specific information salient during processing of other-race faces (Hugenberg, Miller & Claypool, 2007; Levin, 2000). It has been posited that, when processing other-race faces, individuating information is only attended to, to the extent that it is necessary to identify the individual (Rhodes et al., 2009).

This focus on the quality of contact with other-race faces could be argued to explain the increased ability to recognise other race faces found here when learnt in motion. Previous explanations of the motion advantage have suggested that motion information aids recognition because of the supplemental information it provides regarding the identity of the face (O'Toole et al., 2002). As participants were aware that they would have to try to identify the target faces they were learning the individuating information provided by motion may have been attended to and encoded more efficiently than is usually the case when other-race faces are processed with no motivation for identification. In line with this explanation Ng and Lindsay (1994) suggested that a contact hypothesis based merely on the idea that increased exposure leads to better recognition may not be sufficient to remove the race effect. Instead what is necessary to reduce the other race effect is contact in which the goal of an interaction includes the motivation to individuate the face from other exemplars of that race. Furthermore MacLin and Malpass (2001) hypothesised that features which can be used to differentiate individuals within a group (including motion information) will only be learnt to the extent that it is important to differentiate the individuals. Therefore our participants may have made use of all the individuating information available to them in the

learning phase in order to subsequently recognise the other-race faces to the best of their ability. Dynamic characteristics provide individuating information and as such motion information enhanced recognition ability for other-race faces as well as same-race faces.

Second, we found a classic other race effect (Malpass & Kravitz, 1969; Meissner & Brigham, 2001), whereby participants correctly recognised the same race (British Caucasian) target faces more often than other race (Japanese) target faces during the recognition task (Malpass & Kravitz, 1969). There has been much debate about the theoretical underpinnings of the other race effect (for example see Meissner et al., 2005). Practically, the other race effect is important in legal proceedings, with race being one factor that influences the accuracy and reliability of eye witness testimony (Behrman & Davey, 2001). Our experiment demonstrates that the other race effect is also found when using moving images. Thus, race is also likely to be important when identifying people from CCTV footage (see Keval & Sasse, 2008). The present study did not utilise a cross race participant sample so differences due to stimulus sets cannot necessarily be ruled out as a possible explanation of the main effect of race. However, the present study provides preliminary findings to suggest both that motion depicted by other race faces leads to an improvement in recognition ability, as seen for same race faces and that the other race effect is not restricted to static stimuli. Both significant findings that require further converging evidence using cross race participants as well as stimuli.

Third, no overall significant effect of motion at the recognition stage was found (also see Buratto et al., 2009 inclusion condition). This finding is important to the investigation of the role of encoding and retrieval factors (and their interaction) in the recognition advantage for moving faces. It had previously been proposed, based on transfer-appropriate processing accounts of memory (Morris et al., 1977) and study-test congruency effects (Buratto et al., 2009) that the availability of motion at encoding and test would increase the motion advantage demonstrated. Similarly, if participants were rapidly learning characteristic motion information (Lander et al., 2003; Lander et al., 2007; Knight & Johnston 1997) at encoding then we would have expected motion to be particularly useful at recognition, when the face was also learnt moving. In this case, characteristic motion information would have been integrated into the stored face representation at learning, and then retrieved and used as a cue to identity when the face was viewed moving at test (supplemental information hypothesis, O'Toole et al., 2002). We did not find this to be the case, but rather there was

no beneficial effect for non-rigid motion at recognition and no interaction between motion at learning and test. This effect is most likely to be the product of the short exposure time of 2 seconds at learning, leading to too few examples of the target face's motion from which to create a typical representation of that face's motion. Accordingly, Pilz et al., (2009) suggest observers integrate the facial expressions a person produces over time into a representation of facial identity for dynamic targets. Instead the results provide support for the representation enhancement hypothesis (O'Toole et al., 2002), caused by the differentially encoded mental representations for faces dependent on whether they are encoded in static or dynamically. This again provides evidence of differential usages of motion information for the recognition of familiar and unfamiliar faces. Such evidence could be argued to provide support for the separate pathways posited in Bruce and Young's model (1986) for the differential perception of familiar vs. unfamiliar faces. It is also interesting to consider how the fact that viewing a face from a moving clip leads to higher levels of recognition accuracy than when a face was viewed statically at learning and recognition, can be reconciled within the framework's proposed by either the Bruce and Young model or the later IAC model (Burton, Bruce & Johnston, 1990). It may be that the current results are a product of motion information facilitating structural encoding or it may be that learning faces in motion better supports the extraction of an average static representation optimal for subsequent recognition (Burton, Jenkins, Hancock & White, 2005).

Furthermore the current findings suggest that it may be appropriate to consider recognition from a static image as a "snapshot" within an essentially dynamic process wherein the temporal dimension is inextricably rooted in the representation (see Freyd, 1987). This notion, that stored representations are dynamic in nature, is problematic for existing cognitive models of face processing and as such acts to highlight the central role that dynamic features should play in these models in the future (Lander & Bruce, 2003). Indeed mapping the neural pathways of learning and recognising static and moving familiar and unfamiliar faces is of interest to ascertain whether recognition from movement involves the occipital face area (OFA) and superior temporal sulcus (STS) which have been posited to be involved in the changeable aspects of a face (Haxby et al., 2000) and / or the classical face recognition pathway of OFA through to the fusiform face area FFA.



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| Race of Face | Same Race |      |        |      | Other Race |      |        |      |
|--------------|-----------|------|--------|------|------------|------|--------|------|
| Recognition  | Static    |      | Moving |      | Static     |      | Moving |      |
| Learning     | Stat      | Move | Stat   | Move | Stat       | Move | Stat   | Move |
| Hits         | 75.0      | 86.3 | 75.7   | 87.3 | 69.3       | 80.0 | 65.0   | 79.3 |
| SD           | 8.9       | 9.0  | 14.9   | 8.7  | 14.0       | 9.7  | 8.9    | 11.2 |
| FA           | 15.0      | 8.4  | 15.3   | 10.0 | 18.0       | 14.0 | 18.67  | 14.3 |
| SD           | 12.4      | 7.7  | 12.5   | 8.9  | 13.4       | 12.3 | 11.25  | 10.0 |
| A'           | 0.87      | 0.94 | 0.87   | 0.93 | 0.83       | 0.90 | 0.81   | 0.89 |
| SD           | 0.07      | 0.04 | 0.10   | 0.05 | 0.10       | 0.06 | 0.08   | 0.05 |
| B''          | 0.28      | 0.27 | 0.21   | 0.13 | 0.22       | 0.27 | 0.26   | 0.17 |
| SD           | 0.35      | 0.61 | 0.50   | 0.54 | 0.26       | 0.41 | 0.23   | 0.35 |

Table 1: Mean Hits (%), FA (%), A' and B'' with Standard Deviations (SD) in each of the conditions of experiment.